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There is an urgent need for alternative energy carriers, which is due to the limited supply of fossil fuels on the Earth. Much research focused on hydrogen is performed by scientists, governmental and non-governmental institutes, and even many companies. Hydrogen is the most abundant element on the Earth; moreover, the chemical energy per weight of hydrogen (142MJ/kg) is at least three times larger than that of other chemical fuels[1]. However, hydrogen storage is still a key problem remaining to be solved, due to the difficulties of compacting hydrogen. Recent studies demonstrate that metal hydrides can potentially be utilized to solve the storage problem by reversible ab- and desorption of large amounts of hydrogen.

Since Bogdanovic and Schwikardi[2] discovered the catalytic effect of titanium on reversible hydrogen storage in complex metal hydrides, these materials have dominated the research field due to their high theoretical hydrogen storage capacity. Nevertheless, only very little known about physical role of titanium on e.g. hydrogen rotation and diffusion processes. Scattering is a powerful technique to study the micro-phase structure and dynamics of particles with a typical size from 1 to 20,000 nanometers[3]. In this project we use small angle X-ray scattering (SAXS) to investigate the nano- and microstructural evolution during ab- and desorption cycles, e.g. on the metal ammine complex $Mg(NH_3)_6Cl_2$, and quasi elastic neutron scattering (QENS) to obtain information on the effect of $TiCl_3$-doping on hydrogen rotation and long-range diffusion in $NaAlH_4$ and Na_3AlH_6.

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